PROC (BAYL UNIV MED CENT)
2021;34(5):586–587

https://doi.org/10.1080/08998280.2021.1930502

Taylor & Francis
Taylor & Francis Group

Novel use of electromagnetic navigation for thoracostomy tube placement

Sarah Jaroudi, MD[a], David Sotello, MD[b], and Andres Yepes-Hurtado, MD[c]

[a]Department of Internal Medicine, Baylor College of Medicine, Houston, Texas; [b]Pulmonary and Sleep Medicine, CoxHealth, Branson, Missouri; [c]Department of Internal Medicine, Texas Tech University Health Sciences Center, Lubbock, Texas

ABSTRACT

Management of recurrent pleural effusions can be challenging and may require multiple modalities for treatment. Advanced image guidance with ultrasound or computed tomography is often useful for increased accuracy. We demonstrate a novel application of a percutaneous image-guided technique using electromagnetic navigation to successfully place thoracostomy tubes.

KEYWORDS Bronchoscopy; electromagnetic navigation; pleural effusion

Postoperative pleural effusions are common after cardiac surgeries. They may require multiple thoracenteses and/or video-assisted thoracoscopic surgeries (VATS). We present a case of recurrent left-sided pleural effusions after cardiac surgery with successful placement of thoracostomy tubes using electromagnetic navigation technology.

CASE REPORT

A 72-year-old man with chronic obstructive pulmonary disease, obesity, myocardial infarction, and a history of coronary artery bypass grafting (CABG) presented to the pulmonary clinic for evaluation of post-CABG recurrent left-sided loculated pleural effusions. His symptoms included persistent left upper quadrant abdominal and pleuritic pain and dyspnea on exertion. The patient had had multiple unsuccessful left thoracenteses and left-sided VATS with pleurodesis. Computed tomography (CT) of the chest revealed a right free-flowing pleural effusion and left apical and basal loculated pleural effusions.

Due to suboptimal ultrasound views on the left side (related to scar tissue and body habitus), we opted to pursue placement of a left apical (second intercostal space, midclavicular line) and left basal (seventh intercostal space, midscapular line) 14 French pigtail thoracostomy tube using the Spin System™ (Veran Medical Technologies, St. Louis, MO) electromagnetic navigation software and SPiN Perc® *(Figures 1a, 1b)*. Talc pleurodesis was done with 5 g of sterile talc administered through each of the thoracostomy tubes, left in place for 30 minutes, and subsequently suctioned out. Pleural fluid analysis of both pockets showed a lymphocytic transudative fluid with negative bacterial, fungal, and mycobacterial cultures and no evidence of malignancy on cytologic analysis. A follow-up chest radiograph revealed trapped lung in the left apex *(Figure 1c)*. The left apical chest tube was removed 4 days later, and the left basal chest tube was removed 7 days later after no drainage was noted for 24 hours. The left apical pleural effusion did not completely resolve. The patient was discharged without complications.

DISCUSSION

The diagnosis and management of pleural effusions can be very challenging. They require a thorough analysis of the characteristics of each individual patient, along with the radiologic/ultrasound features of the effusion. If the effusion is large enough or associated with symptoms, usually a diagnostic and/or therapeutic thoracentesis will be needed to differentiate the specific etiology of the effusion. This may lead to further procedures if the effusion is causing significant symptomatology or is related to infection, malignancy, or postoperative or structural abnormalities.[1]

Pleural effusions may require multiple interventions such as thoracentesis, thoracostomy tube placement, chemical or mechanical pleurodesis, thoracoscopy, and VATS, with or

Corresponding author: Sarah Jaroudi, MD, Department of Internal Medicine, Baylor College of Medicine, PO Box 591642, Houston, TX 77259 (e-mail: sarah.jaroudi@bcm.edu).

The authors report no conflicts of interest. The patient gave permission for publication of her case.
Received March 4, 2021; Revised May 5, 2021; Accepted May 10, 2021.

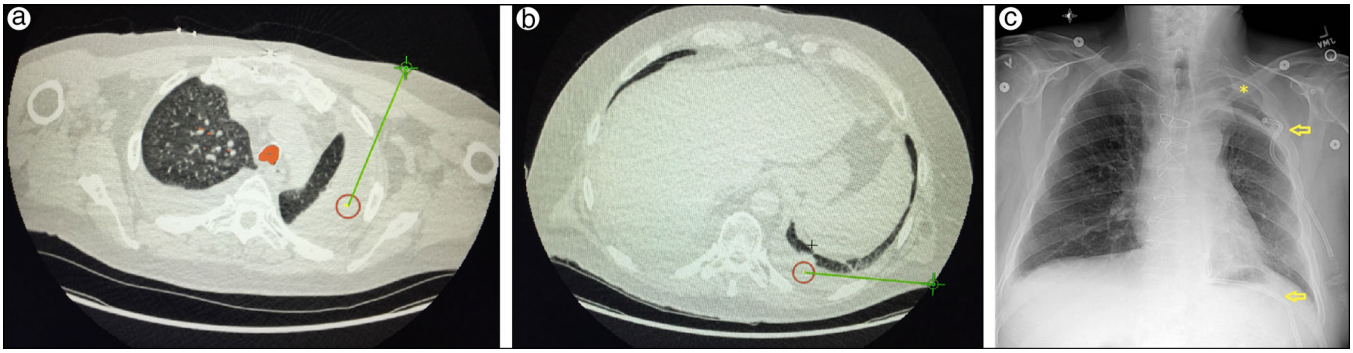

Figure 1. Electromagnetic navigation plan for thoracostomy tube placement of **(a)** left apical and **(b)** basal loculated effusions. **(c)** Chest x-ray showing successful placement of left apical and basal thoracostomy tubes (arrows) and left apical pneumothorax from trapped lung (*).

without decortication.[2] The standard method of tube placement should be attempted using ultrasound, but if image quality and acquisition are poor, then alternate modalities should be explored. Nontraditional uses of technology to drain pleural effusions have included endobronchial ultrasound.[3] Placing a thoracostomy tube using image guidance in cases of loculated pleural effusions can help avoid malpositioning of the tube.[4] Limitations of this technology relate to its cost and the need for specialized procedural experience when comparing it to other modalities used to place thoracostomy tubes. With increased training and individualized application of this technology, cost-effectiveness can be improved.

Electromagnetic navigation technology in the lung, introduced in the 1990s, allows for the creation of virtual three-dimensional bronchial images based on a preprocedural CT chest scan.[5] An extended working channel with a sensor at the tip extends from the bronchoscope, allowing access using virtual reality. It has been routinely used for biopsy of lung lesions, fiducial marker placement, pleural dye marking, and lymph node biopsy. It has even been reported in one case to localize and remove a foreign body.[6] The guidelines of the American College of Chest Physicians recommend electromagnetic navigation bronchoscopy with a 1C recommendation grade for peripheral lung lesions that are difficult to access with traditional bronchoscopy.[7]

In regards to percutaneous introduction of a thoracostomy tube, the electromagnetic software can be used to align placement with the patient's anatomy by uploading a preprocedural imaging study (navigation protocol) into the planning software. The location board is placed underneath the patient, and location pads are placed on the patient's chest to define the sensing area. A trackable percutaneous needle is then calibrated and can subsequently be used to identify the proper trajectory for the thoracostomy tube placement.

The management of recurrent pleural effusions can require multiple interventions. To our knowledge, this is the first case of electromagnetic navigation for percutaneous thoracostomy tube placement for a complicated pleural effusion, representing untapped potential for electromagnetic navigation. More studies are required to clearly establish an advantage of this method compared to ultrasound or conventional CT-guided placement by interventional radiologists. Applications of electromagnetic navigation can be expanded beyond the traditional—to include tube thoracostomy placement and other modalities including rib plating,[8] without being limited to chest interventions.

1. Walker S, Maskell N. Identification and management of pleural effusions of multiple aetiologies. *Curr Opin Pulm Med*. 2017;23(4):339–345. doi:10.1097/MCP.0000000000000388.
2. Feller-Kopman D, Light R. Pleural disease. *N Engl J Med*. 2018;378(8):740–751. doi:10.1056/NEJMra1403503.
3. Cocciardi S, Borah A, Terrigno R, Abouzgheib W, Boujaoude Z. A case report of an expensive yet necessary thoracentesis: Expanding the boundaries of endoscopic ultrasound transbronchial needle aspiration. *Medicine (Baltimore)*. 2019;98(41):e17555. doi:10.1097/MD.0000000000017555.
4. Moulton JS. Image-guided management of complicated pleural fluid collections. *Radiol Clin North Am*. 2000;38(2):345–374. doi:10.1016/S0033-8389(05)70167-6.
5. DiBardino DM, Yarmus LB, Semaan RW. Transthoracic needle biopsy of the lung. *J Thorac Dis*. 2015;7(Suppl 4):S304–S316. doi:10.3978/j.issn.2072-1439.2015.12.16.
6. Karpman C, Midthun DE, Mullon JJ. A distal airway foreign body removed with electromagnetic navigation bronchoscopy. *J Bronchol Interv Pulmonol*. 2014;21(2):170–172. doi:10.1097/LBR.0000000000000049.
7. Detterbeck FC, Lewis SZ, Diekemper R, Addrizzo-Harris D, Alberts WM. Executive summary: Diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest*. 2013;143(5 Suppl):7S–37S. doi:10.1378/chest.12-2377.
8. Pedraza R, Chan EY, Meisenbach LM, Kim MP. Using electromagnetic navigation for intraoperative rib fracture localization during rib plating: A case report. *Int J Surg Case Rep*. 2018;53:386–389. doi:10.1016/j.ijscr.2018.11.029.